COLLECTIVE UNMANNED AERIAL VEHICLE CONFIGURATIONS

BACKGROUND

[0001] Unmanned aerial vehicles ("UAVs") are often designed to carry a payload and/or to remain airborne for a specified duration of time. For example, many multi-propeller aerial vehicles (e.g., quad-copters, octo-copters) are designed to carry a payload of up to ten pounds and remain airborne for up to thirty minutes. To carry larger payloads, the UAV typically has to be larger, with larger motors, larger propellers, and larger power modules to generate lifting forces sufficient to carry the larger payloads. Likewise, for extended flight duration, additional or larger power modules are typically necessary.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] The detailed description is set forth with reference to the accompanying figures. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. The use of the same reference numbers in different figures indicates similar or identical items or features.

[0003] FIG. **1** depicts a view of a UAV configuration, according to an implementation.

[0004] FIG. **2** depicts a top-down view of a plurality of UAVs forming a collective UAV, according to an implementation.

[0005] FIG. **3** depicts a top-down view of a collective UAV configuration, according to an implementation.

[0006] FIG. **4** depicts a top-down view of another collective UAV configuration, according to an implementation.

[0007] FIG. **5** depicts a view of another collective UAV configuration, according to an implementation.

[0008] FIG. **6** depicts a top-down view of a collective UAV configuration with a UAV decoupling from the collective UAV, according to an implementation.

[0009] FIG. **7** depicts a side-view of a collective UAV configuration, according to an implementation.

[0010] FIG. **8** depicts another side-view of a collective UAV configuration, according to an implementation.

[0011] FIG. **9** depicts a top-down view of a collective UAV arriving at a delivery area, according to an implementation.

[0012] FIG. **10** is a flow diagram of an example collective UAV coupling process, according to an implementation.

[0013] FIG. **11** is a flow diagram of an example collective UAV navigation process, according to an implementation.

[0014] FIG. **12** is a flow diagram of a collective UAV decoupling process, according to an implementation.

[0015] FIG. **13** is a flow diagram of a collective UAV planning process, according to an implementation.

[0016] FIG. **14** is a block diagram of an illustrative implementation of a UAV control system that may be used with various implementations.

[0017] FIG. **15** is a block diagram of an illustrative implementation of a server system that may be used with various implementations.

[0018] While implementations are described herein by way of example, those skilled in the art will recognize that the implementations are not limited to the examples or drawings described. It should be understood that the drawings and detailed description thereto are not intended to limit implementations to the particular form disclosed but, on the contrary, the intention is to cover all modifications, equivalents and alternatives falling within the spirit and scope as defined by the appended claims. The headings used herein are for organizational purposes only and are not meant to be used to limit the scope of the description or the claims. As used throughout this application, the word "may" is used in a permissive sense (i.e., meaning having the potential to), rather than the mandatory sense (i.e., meaning must). Similarly, the words "include," "including," and "includes" mean including, but not limited to. Additionally, as used herein, the term "coupled" may refer to two or more components or UAVs connected together, whether that connection is permanent (e.g., welded) or temporary (e.g., bolted, mechanical), direct or indirect (i.e., through an intermediary), mechanical, chemical, optical, or electrical. Furthermore, as used herein, "horizontal" flight refers to flight traveling in a direction substantially parallel to the ground (i.e., sea level), and that "vertical" flight refers to flight traveling substantially radially outward from the earth's center. It should be understood by those having ordinary skill that trajectories may include components of both "horizontal" and "vertical" flight vectors.

DETAILED DESCRIPTION

[0019] This disclosure describes a collective UAV configuration in which multiple UAVs may be coupled together to form a collective UAV. A collective UAV, as used herein, is two or more coupled UAVs. A collective UAV may be used to aerially transport virtually any size, weight, or quantity of items, travel longer distances, etc. For example, rather than using one large UAV to carry a larger or heavier item, multiple smaller UAVs may couple together to form a collective UAV that is used to carry the larger or heavier item.

[0020] In many instances, a single UAV configuration may be capable of delivering a large percentage of the ordered items. However, some items may require a larger UAV that is capable of lifting and aerially transporting a larger or heavier item. Likewise, some orders for items may specify delivery destinations that require a UAV with longer flight duration. Rather than having to maintain multiple UAV configurations or utilize a UAV configuration that is not necessary for the majority of the item deliveries, the implementations described herein utilize multiple UAVs to form a collective UAV that is capable of transporting larger and/or heavier items or aerially navigating longer distances.

[0021] In addition to forming a collective UAV to carry larger and/or heavier items or to aerially navigate longer distances, as described herein, UAVs that are capable of carrying an item independent of other UAVs may couple to form a collective UAV to aerially navigate as a collective UAV to a delivery area. When one or all of the UAVs reach the delivery area, the UAVs may decouple to deliver items to different delivery destinations. By aerially navigating as a collective UAV, the coupled UAVs can share resources (e.g., computing resources, power, navigation, etc.), be more efficient, be more visible, generate larger radar or object detection, be more detectable by ground based radar or air traffic control, etc. For example, a collective UAV that includes multiple coupled UAVs (e.g., twenty) will be more visible to other aircraft as well as air traffic control, thereby improving safety for the UAVs and other aircraft. Likewise, when multiple UAVs are coupled to form a collective UAV,